

- What is heat?

- Transfer of energy at the atomic level

- Three ways to transfer heat:

1. Convection

2. Conduction

3. Radiation

- What is temperature?

- average kinetic energy of molecules of a substance

- Thermal equilibrium: rate of transfer between two objects is equal in both directions
- Zeroth Law of Thermodynamics:  
If objects A and B are in thermal equilibrium with a third object C, then A and B are in thermal equilibrium with each other.



thermal eq.



thermal eq.



thermal eq.

---

- Thermal expansion of solids:

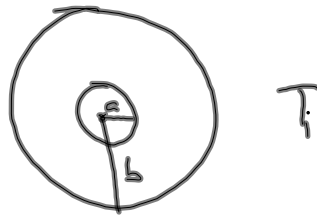
$$\Delta l = \alpha l_0 \Delta T$$

$l_0$  = initial length

$\Delta l$  = change in length

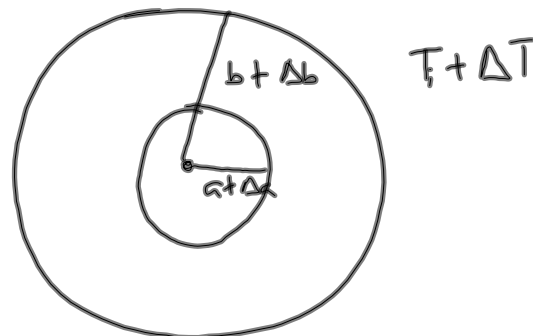
$\Delta T$  = change in temperature

$\alpha$  = coefficient of linear expansion  
unit  $(^{\circ}\text{C})^{-1}$



- What happens to the washer when it is heated?

- Both  $a$  and  $b$  increase



- 
- Real-world applications:

- Expansion joints in bridges and concrete sidewalks
- Bimetallic strip in thermostats

---

$$H = \frac{kA\Delta T}{L}$$

$H$  = rate of heat transfer

$k$  = thermal conductivity

$A$  = surface area

$\Delta T$  = temperature difference

$L$  = length